1. Doll Proportions

What's wrong with that doll?

Focus: proportional reasoning
Materials: dolls and tape measures

Give students a look at the dolls and ask if there's anything not quite human about them. Students will say that the head is too big, the arms are too short, the feet are too small, etc. But are they? Help students see that they can use mathematics to compare the dolls to humans. For example, they might find the ratio of a doll's arm length to its body length (height). Then the same measurements can be taken for students working with the dolls. The ratio will likely be different. If you can get other sorts of dolls you will find that some have more and some have less typically human ratios.

2. Best Bouncer

Focus: NGSS Science & Engineering Practice #3: Planning and carrying out investigations.
Materials: Sets of at least three different kinds of bouncing balls, and measuring tapes.

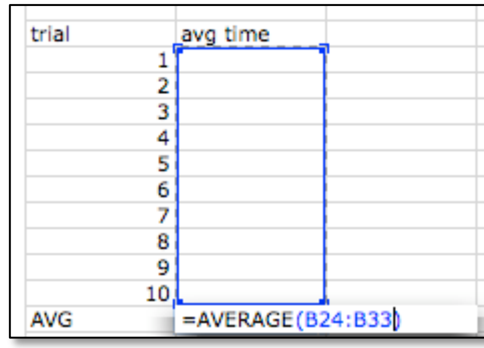
The idea here is to give students a chance to set up an experiment in which a single variable is reliably and validly measured and compared. 5 min.
Show them the balls with which you will be working. "Here are some balls. <u>Are they good bouncers</u>?"

Organize students into groups of 4 or 5. Give each group a bag of balls (one of the pink balls, one mini super ball, and perhaps a ping pong or golf ball or ....) Give them 5 minutes with the balls in order to consider how you would answer that question. Conduct a whole-group discussion of what the various groups think should be done in order to answer the question. (Consider the role of mathematics in the processes of science. It enables quantification, measurement, comparison, verification, replication of data, etc.) Give them 15 - 20 minutes to use the balls and meter sticks or tape measures to gather data with which to answer the question. <u>They will need to be able to tell others why they support one answer or another</u>. => gather data, etc. Give them 15 minutes to construct a compelling argument as to which balls are the best bouncers. A few groups will be chosen to argue their case.

Get some groups to bring their data to the doc cam for display, to support claims, etc. Try to generalize in order to consider the role of math and the nature of the scientific approach to inquiry.

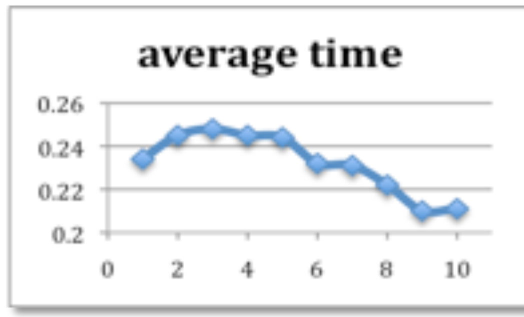
3. *Sheep Dash* from the BBC

Focus: trends in data (CCSSm S.ID.C.7 and 8)
Materials: Access to the Website:
http://www.bbc.co.uk/science/humanbody/sleep/sheep/

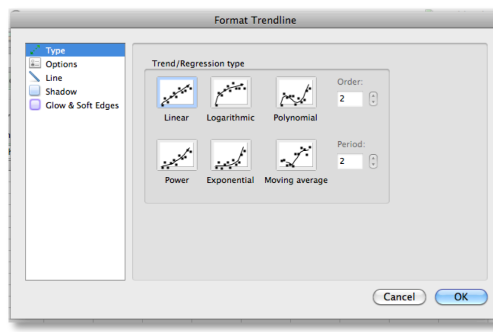


This is a highly engaging (?) way to generate lots of data through measurement of your reaction times. Go to the site and play the game a few times.

Set up a spreadsheet to hold the data:
For now, try 10 rows, 2 columns => 10 sets of 5 trials.

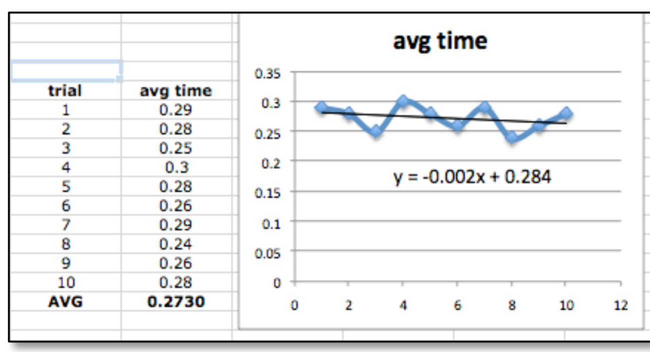


Generate and enter your data then highlight the appropriate range of cells and make an X-Y (scatter) plot.
Click on the plot (line) itself to select all of the points simultaneously then go to the Chart menu to select "Add Trendline…" This will give you a "Format Trendline" dialog box that allows you to do just that. Using the "options" button you can add the trend line's equation so that you can consider the slope of the line (assuming a linear trend line…._).
In the end you will have a chart like this. (see below) Note that you can set it up so that the chart is created and the trend line and equation are adjusted as the data are added. Does the trend line tell you anything about how fast you will be after 20 trials? How about 200??



Activity Outline:

15 min. Gather "baseline" data.
10 min. Do something … to see if it will affect your reaction times (e.g., drink a Mountain Dew or run around the building or meditate or…).
10 min. Gather new data in your altered state.
10 min Analyze the differences between the data sets.
15 min Return to class and discuss how you know what you know.

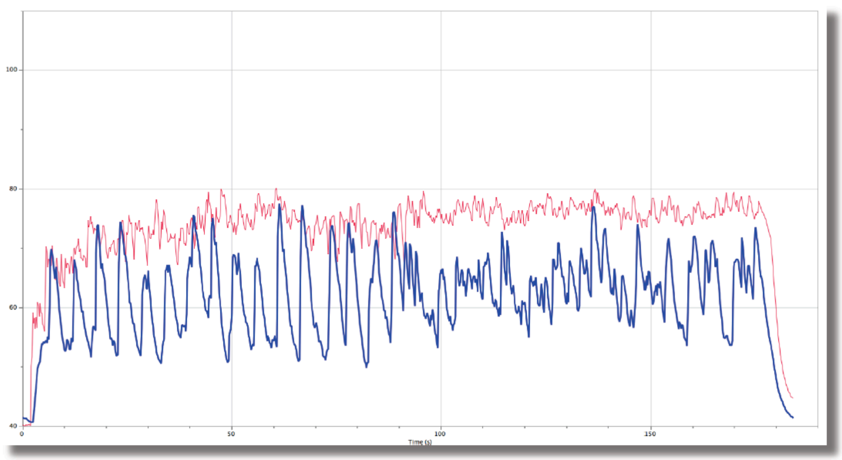


trial	avg time
1	0.29
2	0.28
3	0.25
4	0.3
5	0.28
6	0.26
7	0.29
8	0.24
9	0.26
10	0.28
AVG	0.2730

4. Graphing Music

Focus: Understanding meaning conveyed in a graph ("volume" vs time) with attention to slope and averages
Materials: Sound Probe (e.g., http://www.vernier.com/products/sensors/sound-level-probes/slm-bta/), a means to play music, students' songs.

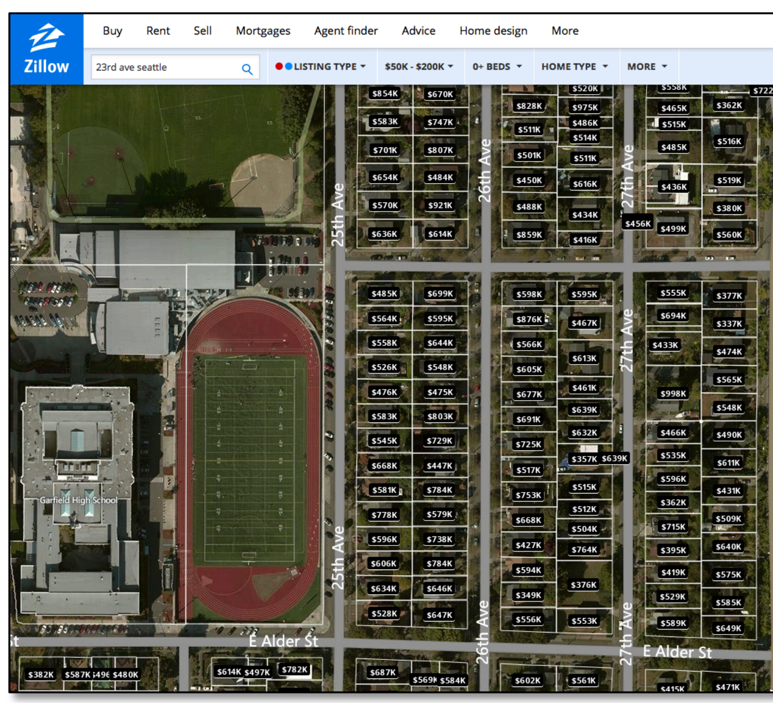
When you have a sound probe, the one linked above or some other, you can use it to sense the volume of ambient sound (in decibels) and see this graphed against time. You can then analyze these graphs for all sorts of characteristics such as average level across a given interval, rate of change, trends in loudness, etc. When students apply these analyses to the traces left by songs they care about their level of engagement is high. Here is a graph for two songs on one set of axes. The more rhythmic of the two is "Uncloudy Day" by the Staple Singers. The more chaotic looking trace was left by "Honkey Tonk Woman" by the Rolling Stones. Time is on the x-axis (~ 3 min. total) and volume is on the y-axis.



Note: The meter can be used as a stand-alone device in which case measurements are read from the LCD screen on the device, or it can be connected to a computer (requires the Go-Link) or TI Graphing Calculator.

5. Zillow

Focus: finding and interpreting means and changes/trends in data
Materials: a Access to the Website: http://www.zillow.com/



In well-populated residential areas you can use Zillow to look at estimated house prices (and rental rates) and use these data to look at ways in which housing prices change around your town. For example, are houses more or less expensive near schools? How do housing prices near schools that serve high-FRPL (Free and Reduced-Price Lunch) populations compare to those near low-FRPL populations? Etc.

6. Infrared Temperature Sensor

Focus: Measurement of temperatures, testing hypotheses, NGSS Science & Engineering Practice #3: Planning and carrying out investigations.
Materials: Infrared remote thermometer

The Temperature Gun is an infrared thermometer that senses temperature remotely and uses a laser to indicate the target area being sensed. Temperatures (°C or °F) are read on a screen on the back of the device. It allows you to read approximate temperatures instantly just by pointing the device and pulling the trigger. Join two or three others at this station, grab one of the "guns" and experiment with it. Think of an investigation that this device enables. If you are short of ideas how about this: We always say that "Heat rises." Use the device to gather data that might help you decide whether this is true or not.

7. Forecast Verification ... or not

Focus: Using data to verify or support a hypothesis and measure a trend in the data.
Materials: Access to long range forecasts (cell phones generally have a weather app)

Weather forecasters often make temperature forecasts for today, tomorrow, (a "one-day" forecast) the next day (a "two-day" forecast), the one after that, etc. often up to a week or ten days out. Are these forecasts accurate? How can we quantify this? What if we kept track of the forecasts for one-day, two-day, three-day etc. up to the ten-day forecast and then kept track of how well they verified. That is, how far the actual reading was from that which was forecast. Intuitively, it seems as though the short-term forecasts ought to be more accurate than the long-term forecasts but is that the case? Set up a spreadsheet to hold and make calculations with forecast data and find out. This makes a nice long-term project, taking at least ten days to complete and allowing for new data calculations every day.

8. FitBit

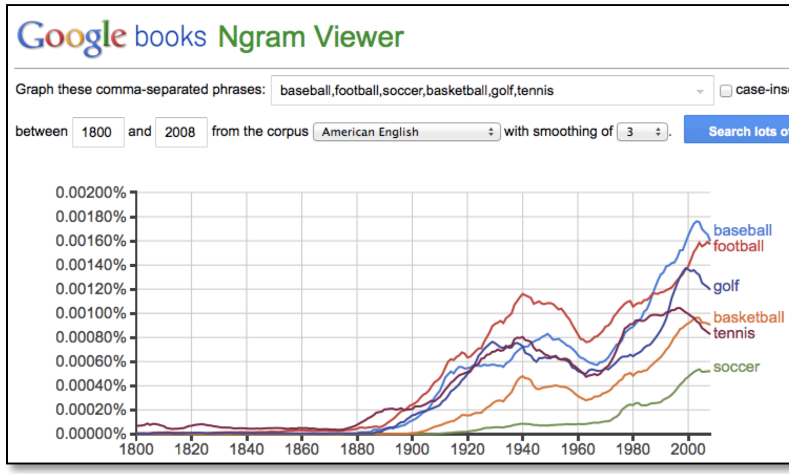
Focus: Quantification of activity. Data collection, tracking, and representation
Materials: a fitbit or similar product, or a simple pedometer (old school)

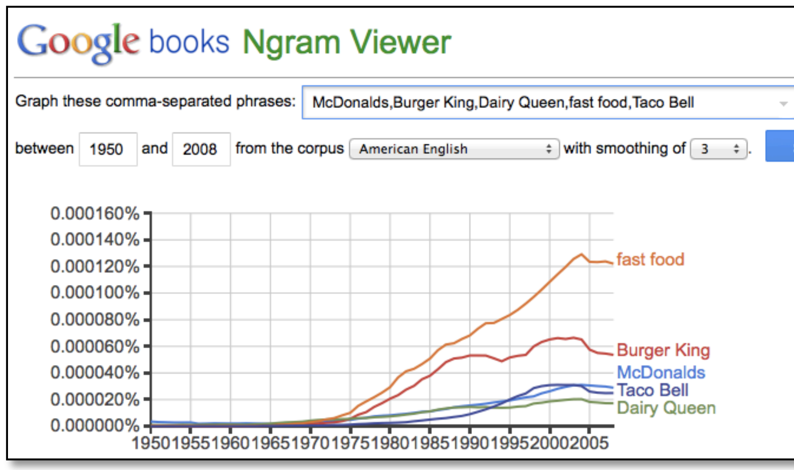
Pedometers have been around for a very long time but the new(ish) activity trackers are very popular now. They allow you to quantify the amount of activity you get in a day. (Before I lost it…) I owned one of these and found myself checking often to see how may steps I had taken and wondering whether I would reach my goal (10,000 steps) for the day. If I missed it on Monday and Wednesday, could I make it up on days throughout the rest of the week so that my weekly total would still yield an average over 10,000? How many steps do I get when I walk to Safeway? Will it be the same on the way back? What if I take a different route? How accurately can I estimate distances and steps? So many opportunities to use mathematics to make sense of life!

9. Ngram Viewer (Google)

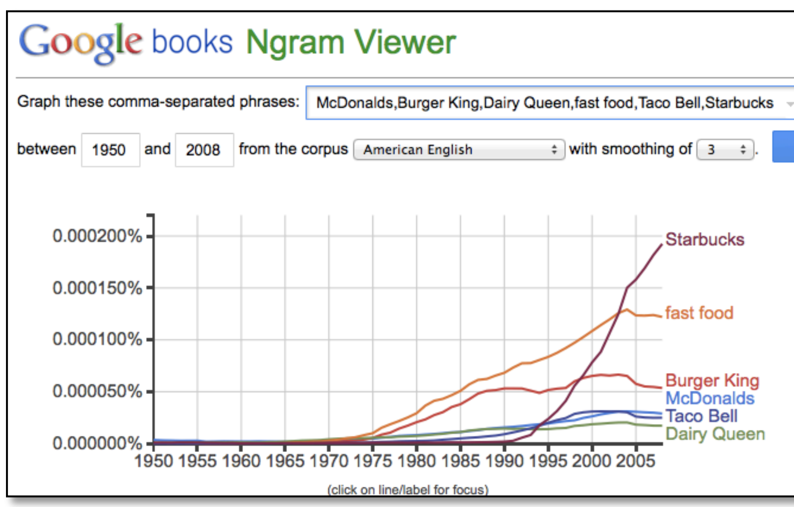
Focus: Understanding data and data representations
Materials: Access to the Website: https://books.google.com/ngrams

Google's Ngram Viewer takes advantage of the fact that Google has been scanning books for years now and they have accumulated quite a database. That database can be accessed and queried in some simple and not so simple ways. For instance, I can ask for the frequency with which the words baseball, football, soccer, golf and tennis have occurred in books they have scanned. The default is to query English language books published between 1800 and 2000 but if I wished to do so I could look at, for example the results for books in Chinese between 1966 and 1976, or Italian from 1750-1820, etc. How about "fast food," "McDonalds," "Burger King," "Dairy Queen" and "Taco Bell"?





What happens if we add "Starbucks" to the search?



Notice that the scale on the y-axis had to change. Notice also that .000200% is not a very big number. (What does it mean exactly?) If we search for "the," during the same period, it is relatively steady at about 4.5% which means it's about 22,500 times more often than "Starbucks" at its peak.

Students can use this website to search for terms that interest them. Teachers can use that interest as a springboard to work on getting them involved in examination of graphs, the significance of scale and representations of data in general.

10. Temperature Probes

Focus: Measurement of temperatures, testing hypotheses, NGSS Science & Engineering Practice #3: Planning and carrying out investigations.
Materials: Temperature probe(s) e.g.,
http://www.vernier.com/products/sensors/temperature-sensors/go-temp/

We have had a set of temperature probes for several years and I never stop finding new uses for these handy and relatively inexpensive (~$39) probes. Plug them into your computer 9USB) and use the supplied software to track and analyze temperature sensed by the probe. For today, try these two simple investigations:

1. What will happen when probe 1 is dipped in Isopropyl Alcohol, probe 2 is dipped in water, and probe 3 is dipped in vegetable oil, then all three are withdrawn and allowed to dry for 90 seconds?

2. What will happen to the temperature of vinegar when a little baking soda is added? (Is this and exothermic or an endothermic reaction?)

When you are ready to collect data, click the green “Collect” button 

at the top of the screen (or if it is red, click it to stop collection of data and it will go back to green.) If the program asks you about erasing data and whether you want to or not, in most cases it’s best to just pick “Erase and Continue.”

11. Wolfram Alpha

WolframAlpha

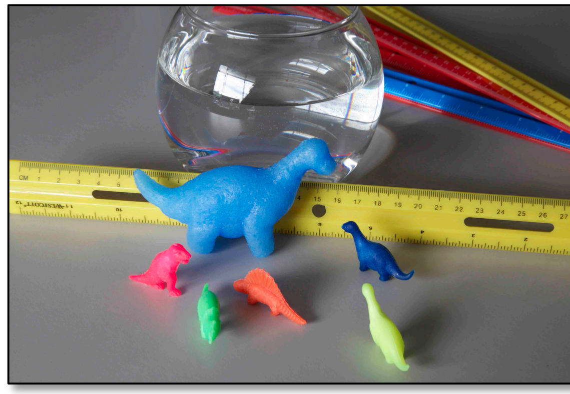
Focus: Quantification, analysis and representation of quantity (which is pretty much “math.”)
Materials: Access to the Website: http://www.wolframalpha.com/

Wolfram Alpha has become quite an extraordinary site for quantifying, analyzing and representing life. You get a strong hint of this as soon as you open their homepage. You can explore via the links there but here are a few specific paths that will demonstrate some of the quantifying power and potential of this site:

On the front page, click on the first link, “Mathematics.”
Click on the addition example (125+375), at the top of the list. Simple but interesting… Go back to “Mathematics.” Then click on the “Plotting and Graphics” example. Go back. Then enter something of your own, for example, $x^2 - 4x + 24 = 45$. It will solve it, and more…. Now go back out to the beginning and type in your name. LOTS of information. Try searching for your birth date. E.g., “June xx, 19xx.”

Now try the name of the city where you were born and your birth date. E.g., “Spokane, May 12, 1958.” ….

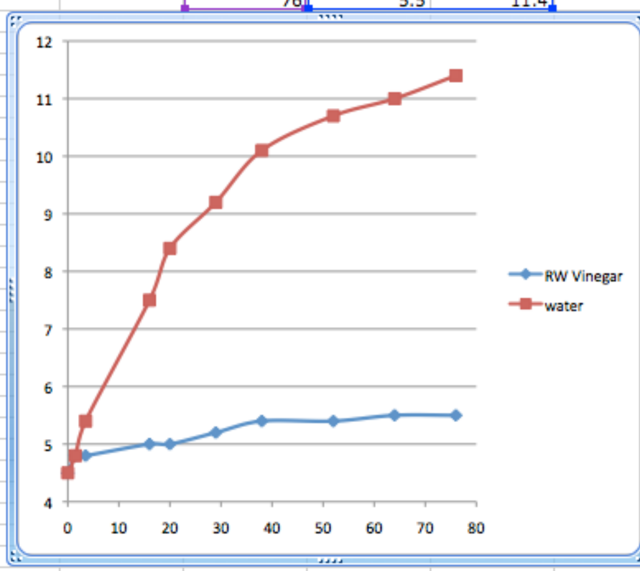
12. Grow Beasts



Focus: measurement, data analysis, NGSS Science & Engineering Practice #3: Planning and carrying out investigations. CCSSm Practice #4: Model with Matematics.
Materials: Grow Beasts, bowls or ziplock bags, rulers

The grow beast is a small, inexpensive, readily available toy that, when placed in water, absorbs it and thus "grows" over the course of several days, then gradually shrinks to more or less its original size when removed from the water. Some are dinosaurs but others are bugs, sea creatures, lizards and just about everything else that can be molded from this special substance, a superabsorbent hydrophilic (water-loving) polymer. This is like the stuff you will find if you slice open a disposable diaper. Its key feature is that it absorbs liquid. In a diaper it is formulated so as to do this very quickly. In a grow beast the process takes days. They do this in water. They do it in milk. They do it in coffee. They'll do it in root beer if you give them a chance. But in each of these liquids they grow and shrink at <u>different rates</u>. That's part of make them so worthwhile in a math or science classroom. Students can predict, measure, record, analyze, predict again with new data, etc. and all in a context – watching a dinosaur "grow" that is engaging and fun.

hours elapsed	RW Vinegar	water
0	4.5	4.5
1.5	4.8	4.8
3.5	4.8	5.4
16	5	7.5
20	5	8.4
29	5.2	9.2
38	5.4	10.1
52	5.4	10.7
64	5.5	11
76	5.5	11.4



More information than anyone really needs, including where to get them for about $.25 apiece, is to be found on my Grow Beast wikispace: http://growbeast.wikispaces.com

See me if you want more information about these things or how to use them in a classroom.

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